DOCUMENT RESUME

ED 155 015 SE 024 263

AUTHOR	Schwing, Carl M.
TITLE	A Guide for Developing Standard Operating Job Procedures for the Sludge Conditicning & Dewatering Process Wastewater Treatment Facility. SOJP No. 11.
INSTITUTION	Charles County Community Coll., La Plata, Md.
SPONS AGENCY	Environmental Protection Agency, Washington, D.C. Div. of Manpower Training.
PUB DATE	May 73
GRANT	EPA-900253
NOTE	59p.; For related documents, see SE 024 261-262 and SE 024 091-097; Not available in hard copy due to marginal legibility of original document
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Guides; Industrial Training; *Instructional Materials; *Job Training; Post Secondary Education; Safety; Utilities; *Waste Disposal; *Water Pollution Control; Water Resources
IDENTIFIERS	*Sludge; *Waste Water Treatment

ABSTRACT

This guide describes standard operating job procedures for the sludge conditioning and dewatering process of wastewater treatment facilities. In this process, sludge is treated with chemicals to make the sludge coagulate and give up its water more easily. The treated sludge is then dewatered using a vacuum filter. The guide gives step-by-step instructions for pre-startup, startup, continuous operating, shutdown, and preventive maintenance procedures. (BB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED155015

S.O.J.P.

11

SOJP NO 11

SLUDGE CONDITIONING & DEWATERING

A GUIDE FOR THE DEVELOPMENT OF

STANDARD OPERATING JOB PROCEDURES

FOR WASTE WATER TREATMENT PLANT UNIT OPERATIONS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Bernard Lukco

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

DEVELOPED BY
CHARLES COUNTY COMMUNITY COLLEGE
LA PLATA, MARYLAND

GRANT NO 900253
MANPOWER DEVELOPMENT STAFF,
ENVIRONMENTAL PROTECTION AGENCY.

SE 024 263

A GUIDE FOR THE DEVELOPMENT
OF
STANDARD OPERATING JOB PROCEDURES
FOR
WASTEWATER TREATMENT PLANT
UNIT OPERATIONS

BY
CHARLES COUNTY COMMUNITY COLLEGE
LA PLATA, MARYLAND

FOR

MANPOWER DEVELOPMENT STAFF
OFFICE OF WATER PROGRAMS OPERATIONS
ENVIRONMENTAL PROTECTION AGENCY

GRANT NO. 900253

MAY 1973

The mention of trade names or commercial products in this manual is for illustration purposes and does not constitute endorsement or recommendation for use by the Environmental Protection Agency.

Contents of this manual do not necessarily reflect the views and policies of the Environmental Protection Agency.

A GUIDE FOR DEVELOPING

STANDARD OPERATING JOB PROCEDURES

FOR THE

SLUDGE CONDITIONING & DEWATERING PROCESS

WASTEWATER TREATMENT FACILITY

SOJP NO 11

Developed by Charles County Community College under
a grant with the

Manpower and Training Staff
Office of Water Programs Operations
Environmental Protection Agency

Standard Operating Job Procedures for the Sludge Conditioning & Dewatering

This Process was developed by:

Name Carl M. Schwing

Address P.O. Box 517, La Plata, Maryland 20646

Position Sanitary Engineer

Education and Technical Background B.S. Chemistry, Xavier University, Cincinnati, Ohio, Graduate Studies, Civil and Environmental Engineering, Washington University, St. Louis. Registered Professional Engineer, Missouri; Certified Wastewater Treatment Plant Operator Class "A" Maryland

Name Thomas T. Schwing

Address P.O. Box 517, La Plata, Maryland 20646

Position Wastewater Treatment Plant Technician

Education and Technical Background Data Processing, Xavier University, Cincinnati, Ohio; Wastewater Treatment Plant Operator, Howard County, Maryland.

SOJP NO 11

PAGE NO 1

Process Sludge Conditioning & Dewatering

1. Operation Objectives

2. Brief Description of Process

1. Sludge is treated with chemicals so as to make the sludge coagulate and give up its water more easily. The treated sludge is then dewatered by applying vacuum by means of a vacuum filter.

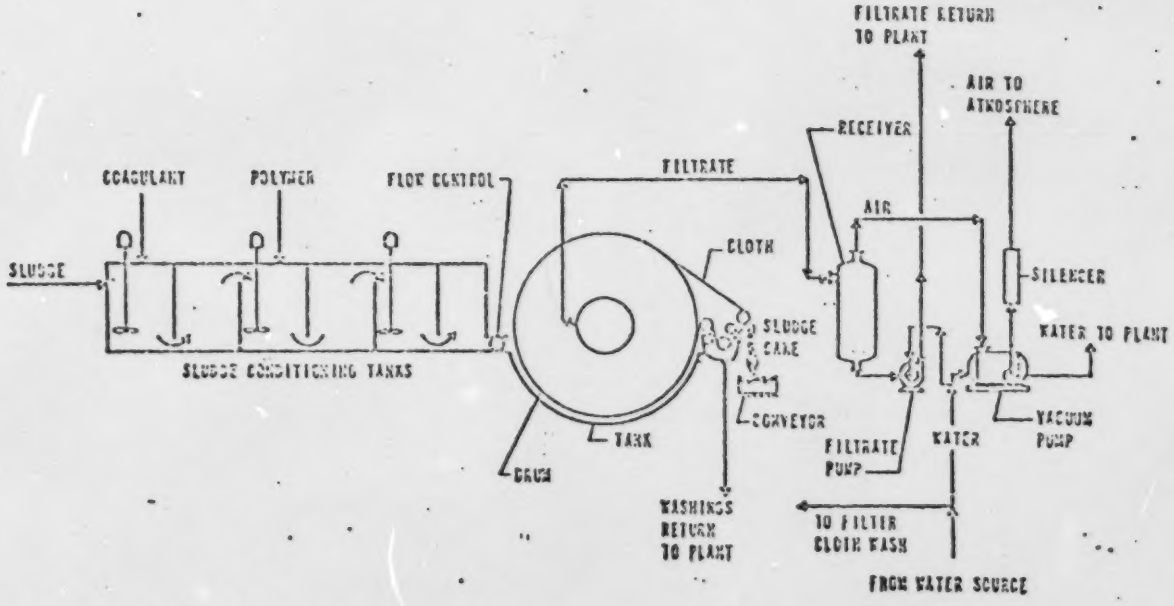
2. Raw or digested sludge is pumped to a chemical mixing tank where sufficient, ferric chlorine and lime, and/or polymers are added to neutralize the electrical charges on the sludge particles. After a brief period of mixing, 15 to 60 seconds, the coagulated sludge flows to the vat of the vacuum filter. As the filter drum rotates, a thin layer of sludge 1/4" to 5/8" in thickness, is picked up on the filter media. This filtrate is removed by a filtrate separator and filtrate pump and discharged to the plant sewer. By the time the drum has rotated approximately 240°, the sludge has been dewatered to a point where its moisture content is approximately 60 to 80 percent. At this point the filter cake is discharged for disposal in the incinerator or at a sanitary landfill.

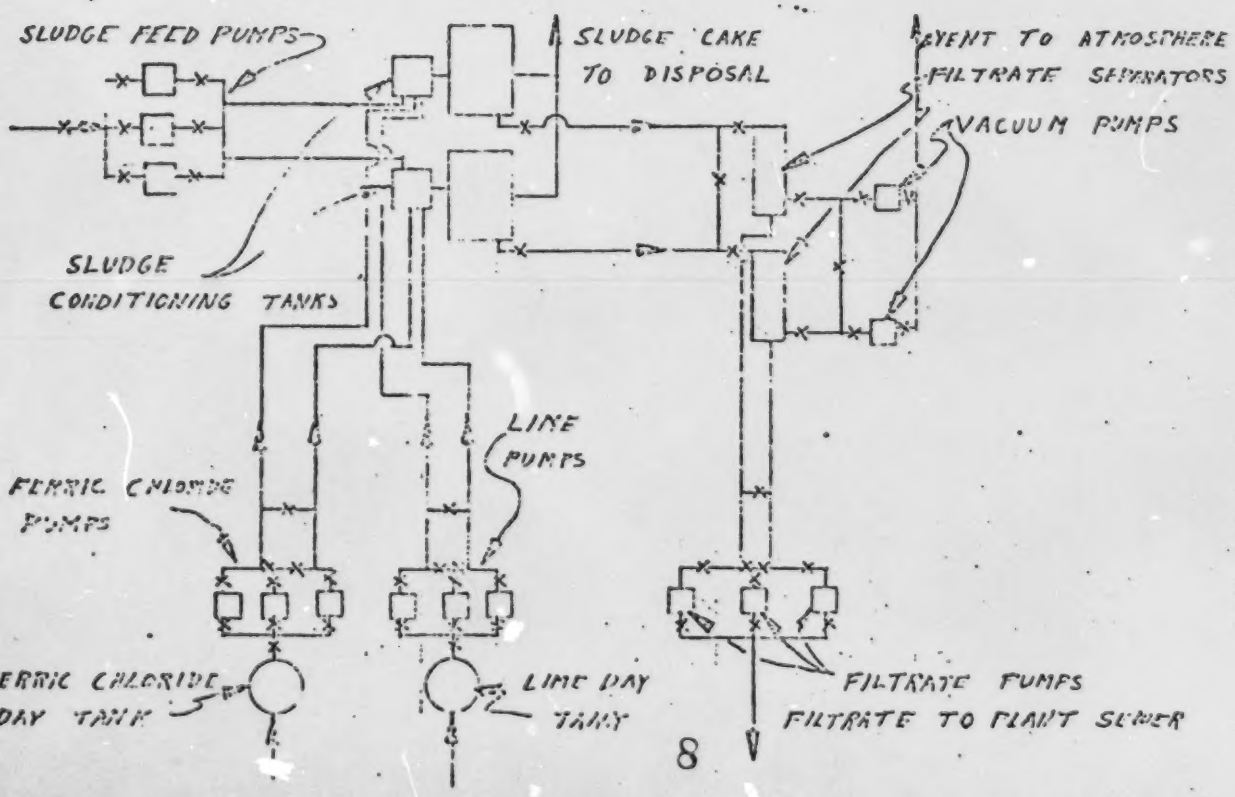
SOP No. 11

Unit Operation Sludge Conditioning & Dewatering

Flow Diagram

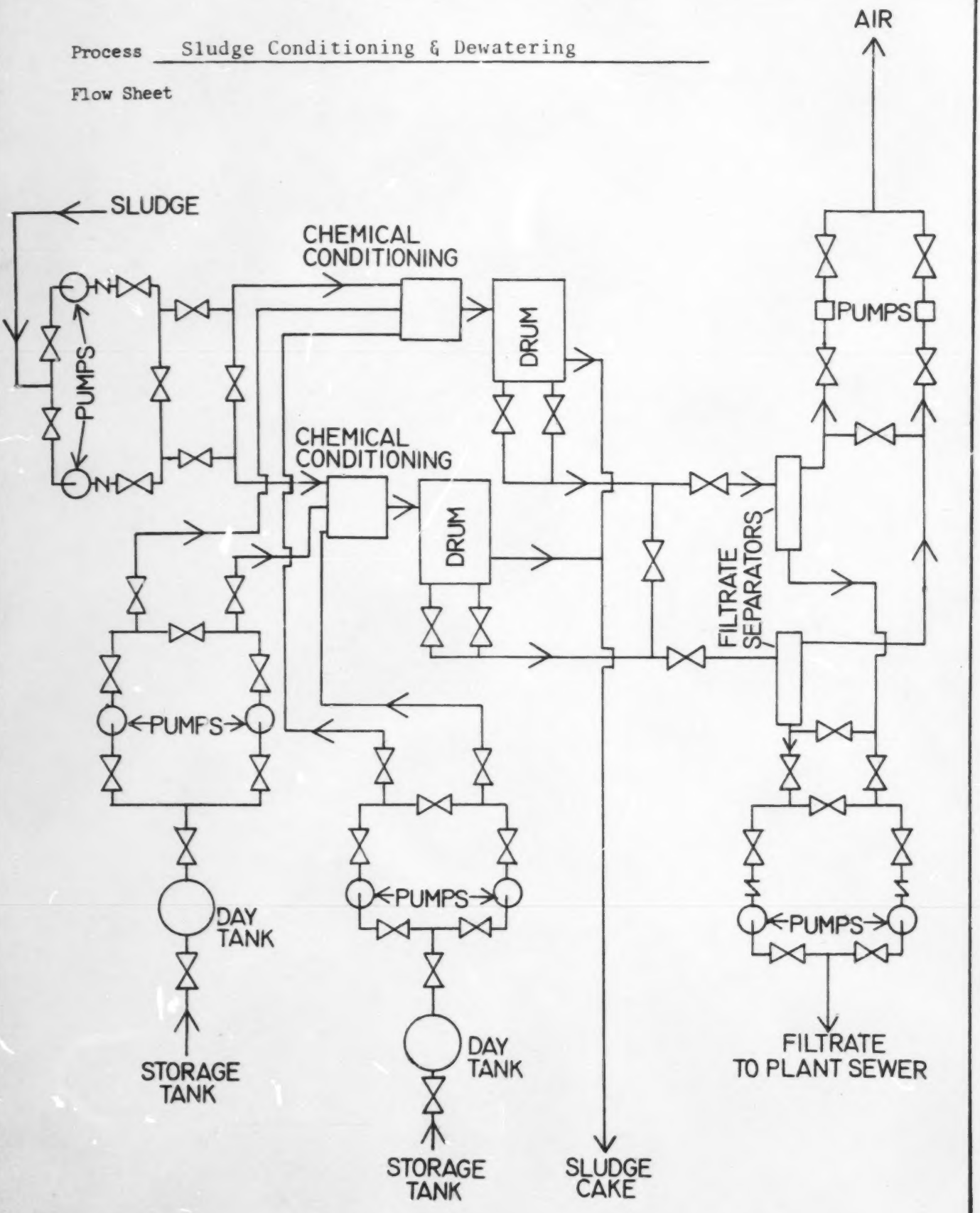
TYPICAL VACUUM FILTER FLOW DIAGRAM





Process Sludge Conditioning & Dewatering

Flow Sheet



Process Sludge Conditioning & Dewatering

General Description of Equipment Used in the Process

Three piston pumps each with the capacity of 50 GPM pump the sludge to be processed from the sludge holding tank through the sludge conditioning tanks into the vacuum filter vats. The valves for these pumps are so arranged that any of the three pumps may be used to feed either filter. These pumps are equipped with electrically adjusted variable speed drives, a bubbler system in each filter vat. Adjust the pumping rates so as to maintain a given level in the filter vats.

A rubber lined 500 gallon per day tank receives concentrated ferric chloride from the chemical treatment section of the plant. This concentrated ferric chloride is diluted to an 11% solution by the addition of an amount of water determined by use of a nomograph. This is checked with a hydrometer to determine its specific gravity. Three diaphragm pumps each with the capacity of 1.5 GPM pump the 11% ferric chloride solution to the sludge conditioning tank. The valves for these pumps are arranged so that any of the three pumps may be used to feed either sludge conditioning tank. These pumps are equipped with electrically adjusted variable speed drives through the use of a porportional signal. The output of the ferric chloride pumps is adjusted to changes in the output of the sludge feed pumps.

A 10% slurry of lime is pumped to a 500 gallon lime storage day tank on the filter floor. From this day tank three diaphragm pumps each with a capacity of 3.5 GPM pump the lime slurry to the sludge conditioning tank. The valves for these pumps are so arranged so that any of the three pumps may be used to feed either sludge conditioning tank. These pumps are also equipped with electrically adjusted variable speed drives. Like the ferric chloride pumps a porportional signal is utilized to adjust the output of the lime slurry pumps to correspond to changes in the output of the sludge feed pumps.

There are two vacuum filters each with an effective filter area of 275 square feet. Each vacuum filter is equipped with its own sludge conditioning tank which has a variable speed drive to adjust the speed of mixing. The detention time in the sludge conditioning tank is approximately one minute. The vacuum filters are equipped with the variable speed drive so that the speed of rotation of the drum can be adjusted. Likewise, an agitator is provided to keep the contents of the vat well mixed during the filtration cycle. This agitator is also equipped with a variable speed drive as well as a timer to turn the agitator on and off at regular intervals.

Process Sludge Conditioning & Dewatering

General Description of Equipment Used in the Process

The dewatered cake is discharged onto a conveyer belt which discharges either into a sludge truck for hauling the cake to the landfill or into a multiple hearth incinerator for incineration.

Two vacuum pumps each with the capacity of 415 cubic feet of air per minute at 26 inches of mercury supply the vacuum to dewater the sludge. The filtrate which is withdrawn from the sludge as it is dewatered is separated from the flow of air by use of filtrate separators. The filtrate is withdrawn from the separators by filtrate pumps. The discharge from the vacuum pumps is exhausted to the atmosphere. The piping from the vacuum pumps is so arranged that either vacuum filter can be serviced by any combination of filtrate separator and vacuum pump.

Three centrifugal pumps each with a capacity of 50 GPM pump the filtrate from the filtrate separator to the plant sewer. The valves for these pumps are so arranged that any of the three pumps may be used for either filtrate separator.

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditiong & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRE-START-UP	INSPECTION PROCEDURES		I-1
1. Safety Inspection	1. Make certain all valves are closed.	1. If valve operation is not proper- stop.	V-1
	2. Lock Out Switch gear.		V-3, XII-1
2. Physical Building Inspection	1. Physically inspect the interior of all tanks and vats for obstruction.		V-2
	2. Fill vats and tanks with clear water and check for leaks.		V-2
	3. Dewater tanks and vats.		V-2
	4. Remove debris from all conveyor belts.		V-2
	5. Check all lines for leaks.		V-2
3. Electrical Inspection	1. Check electrical switching gear for proper nomenclature and operation.	1. Refer to equipment maintenance records for proper overload heater size.	V-3

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	2. Unlock and activate switch gear.	1. Measure voltage at all points up to Motor disconnect.	V-3
	3. Bump motors.	1. Check for proper direction of rotation.	V-3
	4. Check overload alarm circuits and devices for proper operation.		
4. Equipment Inspection	1. Check all pumps for proper operation. a) Rotation b) Packing or seal c) Lubrication d) Variable speed drive	1. Rotates freely 2. Check for proper amount of leakage 3. See Lab Schedule 4. Check entire range or variable drive.	XI-1 XII-2
	2. Check sludge chemical conditioning tanks for proper operation. a) Lubrication b) Freedom of movement c) Variable speed drive.	1. Rotates freely 2. Check for proper amount of leakage 3. See Lab Schedule 4. Check entire range or variable drive	V-5
	3. Check vacuum filters for proper operation. a) Vat agitation	1. Lubrication 2. Freedom of movement 3. Variable speed drive	XII-2, XII-3 XI-1

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditionditioning & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	4. Check converors for proper operation.	1. Alignment of rollers	V-7,XII-4
	5. Check sludge cake scale for proper operation utilizing calibrated chain.		V-8, XI-1 XII-4
	6. Check vacuum pumps for proper operation. a) Lubrication b) Freedom of movement c) Cooling water system		V-9
	7. Calibrate ferric chloride and lime diaphram pumps for number of gallons discharged per stroke.	1. To save time in the future, it is best to prepare graphs with the output plotted versus speed setting.	V-4, X-2 XI-1

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURE			
1. Equipment Start-up	1. Determine proper ferric chloride and lime dosage by performing sludge filterability studies in laboratory.	1. See Training Guide.	III-1, VII-1, X-1
	2. Notify incineration operator or sludge disposal truck driver of anticipated start up time.		
	3. Fill ferric chloride day tank with sufficient $FeCl_3$ and water to make up a 11% solution. Notify Chemical treatment section operator.	1. Use nomograph and hydrometer.	III-1, VII-2 XII-5
	4. Fill lime day tank with sufficient lime slurry and water to make up a 10% solution. Notify Chemical treatment section operator.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	5. Determine solids concentration of sludge in sludge holding tank by perfoming 15 minute sludge centrifuge test as described in SOJP 9		VI-2
	6. Select desired sludge pump and open all necessary valves between sludge holding tank and vacuum filter.		
	7. Select desired ferric chloride pump and open all necessary valves between ferric chloride day tank and sludge conditioning tank.		
	8. Select desired lime pump and open all necessary valves between lime day tank and sludge conditioning tank.		
	9. Select desired vacuum pump and open all necessary valves between vacuum filter and discharge to atmosphere.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

PROCESS Sludge Conditioning & Dewatering

Prepared by C.M.Schwing T.T.Schwing Date 5-73

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	10. Select desired filtrate pump and open all necessary valves between filtrate receiver and plant drain.		
	11. Start selected sludge pump.		
	12. Start Ferric Chloride pump and adjust for proper dosage.		
	13. Start lime pump to adjust for proper dosage.		
	14. Start sludge conditioning tank drive unit.		
	15. Start selected vacuum pump.		
	16. Start vacuum filter agitator.		
	17. Start vacuum ilter drive as soon as bottom of drum is submerged 2 inches.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

PROCESS Sludge Conditioning & Dewatering

Prepared by C.M.Schwing T.T.Schwing Date 5-73

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	18. Start selected filtrate receiver pump. 19. Turn on filter cake scale. 20. Start filter cake conveyor and notify sludge incinerator operator or sludge disposal tank driver.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION PROCEDURES			
1. Continuous Operating Equipment	1. Operator should maintain constant visual observation of vacuum filter and filter cake conveyor for abnormal operating.	1. Check for media alignment 2. Check for blinging	VIII-5
2. Equipment Inspection and process admustment	1. Determine Sludge Solids concentration by use of 15 minute centrifuge test.	1. Solids concentration should be greater than 3% but less than 12%.	VI-3, VII-3 VIII-1
	2. Check and record the following: 1. Ferric chloride day tank depth. 2. Lime day tank depth. 3. Sludge pump libri-cation. 4. Filter vacuum 5. Drum speed setting 6. Vat agitator speed setting. 7. Recored the follow-ing:	1. Vacuum on drying cycle should be 20-26"Hg 2. Vacuum on pick up cycle should be 16-20" Hg.	IV-1, VI-4 VII-4, VIII XIII-1

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M.Schwing T.T.Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	1. Gallons sludge fed. 2. Gallons ferric fed. 3. Gallons lime fed. 4. Tons [illegible] cake and disposal		
	8. Calculate 1. Gallons sludge fed/hr. 2. Pounds of sludge fed/hr. 3. Ferric chloride feed-GPM 4. Ferric dosage % 5. Lime feed-GPM 6. Lime dosage % 7. Filter yield-lbs/sq ft/hr.		
	9. Perform sludge cake moisture test and record.		
	3. Take the following composite sample for lab. 1. Sludge to filter 2. Filtrate 3. Sludge Cake		III-1, VI-3 VI-4, VI-5 VIII-2, X-3 X-4, VIII-4

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

PROCESS Sludge Conditioning & Dewatering

Prepared by C.M. Schwing T.T. Schwing Date 5-73

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
3. Equipment Inspection & Process Adjustment	1. Lubricate filter drum, agitator and rollers as required.		
	2. Clean flushing water strainer.		
	3. Take samples composited on shift to central refrigerated storage.		
	4. Complete formen's report.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M. Schwing T.T. Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
D. SHUT DOWN PROCEDURE			
1. Standby Shut Down	Filters may be placed on "Stand-by" for up to 2 hours by carrying out the following sequence: 1. Shut off filter drum drive. 2. Shut off sludge feed pump. 3. Shut off ferric chloride feed pump. 4. Shut off lime feed pump. 5. Shut off chemical conditioning tank drive. To reactivate filter after stand-by period, start up Units that have been shut off in Steps 1 through 5 alone, but in reverse order.		
2. Complete Shut Down	1. Nofity incinerator operator or sludge disposal truck operator of approximate shut down time. 2. Plan ahead so that there will be a minimum amount of		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M. Schwing T.T. Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	2. ferric chloride and lime in day tanks at shut down time if both filters are to be shut down. 3. Shut off sludge feed pump. 4. Shut off ferric chloride feed pump. 5. Shut off lime feed pump. 6. When sludge level in filter vat drops to edge of drum and last of cake has been discharged onto cake conveyor, drain filter vat to plant sewer. 7. Drain lime day tank to plant sewer and hose out with fresh water. 8. Shut off vacuum pump. 9. After ten minutes, shut off vacuum pump cooling water.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M. Schwing / T.T. Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	10. Shut off filtrate pump. 11. Pump fresh water through line system until it runs clear at chemical conditioning tank. 12. Close all ferric chloride valves between day tank and sludge conditioning tank. 13. Close all lime valves between day tank and sludge conditioning tank. 14. Drain sludge in line between sludge feed pump and sludge conditioning tank to plant sewer. 15. Hose out sludge conditioning tank. 16. Shut off sludge conditioning tank drive unit. 17. Hose out filter vat.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M. Schwing T.T. Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	18. When last of filter cake has been discharged, shut off filter cake conveyor drive. 19. Rotate filter drum for two hours with media wash sprays on full. 20. Shut off wash sprays. 21. Shut off filter drum drive.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M. Schwing, T.T. Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
E. PREVENTIVE MAINTENANCE (MAY BE DONE BY OTHERS)			
1. Routine Preventive Maintenance on Equipment	1. Lubricate and operate all valves annually.	1. See PM schedule	IV-1, V-1, IX-1
	2. Inspect pumps and carry out preventive maintenance.	1. See PM schedule for frequency and work detail.	IV-1, V-3, IX-2
	3. Inspect vacuum filter and carry out preventive maintenance 1. Drive unit Lubricate Wear 2. Media Wear Clean with detergent or acid as needed. 3. Agitator Lubricate Wear 4. Drum		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11 Prepared by C.M. Schwing T.T. Schwing Date 5-73

PROCESS Sludge Conditioning & Dewatering Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	Wear and clogging on vacuum lines. Wear and Clogging on vacuum head. Protective coating.		
	4. Inspect motors annually.		IV-1, V-10, IX-4, XII-1
	Lubrication Electrically	1. Meg insulation and record 2. Check voltage and record 3. Check current and record	
	5. Inspect vacuum pump and carry out preventive maintenance.		IV-1, V-9, IX-5
	6. Inspect protective coating of ferric chloride and lime day tanks.		IV-1, IX-6
	7. Measure and record amount of vacuum loss in system between filter head and vacuum pump.		IV-1
	8. Inspect sludge cake discharge conveyor		IV-1, V-7, IX-7
	1. belt for wear and tear		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 11

Prepared by C.M. Schwing
T.T. Schwing

Date 5-73

PROCESS Sludge Conditioning & Dewatering

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	2. drive unit motor gear reducer lubrication 3. drums and rollers freedom of movement lubrication alignment tension		

TRAINING GUIDE

SECTION	TOPIC
I	Operating Theory
II	Educational Concepts - Mathematics
III	Educational Concepts - Science
IV	Educational Concepts - Communications
V	Process Equipment
VI	Process Flow - Characterization
VII	Process Control
VIII	Abnormal Operations - Trouble Shooting
IX	Maintenance Practices
X	Laboratory Practices
XI	Instrumentation - Automation
XII	Safety Practices
XIII	Records Reports

OPERATING THEORY

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
I-1 (A)	Sludge Conditioning & Dewatering	WPCF MOP #14 Sections 11.2, 11.3, 11.4 WPCF MOP #11 Chapters 8 and 9 WPCF MOP #8 Sections 15.3, 15.4 and 15.6 Texas Manual pp 305-308, Chapter 19 pp 371-382 New York Manual pp 96-107 JWPCF 36, 12, 1460 37, 8, 1180 38, 2, 248 38, 2, 271 37, 12, 1643 38, 2, 186

EDUCATIONAL CONCEPTS - MATHEMATICS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES

Given: Sludge fed in 2 hours = 2860 gallons
Sludge solids concentration by centrifuge test = 9%
Ferric chloride consumed in 2 hours = 68 gallons
Lime consumed in 2 hours = 236 gal.
Lime slurry concentrate = 10%
S.G. of $FeCl_3$ = 1.093
Filter area 275 square feet

Determine: Filter yield
$FeCl_3$ dosage
Lime dosage

$FeCl_3$ dosage

At S.G. of 1.093 1 gal contains 1 lb $FeCl_3$

2860 gallons x 8.34 lbs x .09 = 2147 lg dry solid

$FeCl_3$ dosage = $\frac{\text{pounds } FeCl_3}{\text{pounds dry solids}}$ x 100 =

= $\frac{68}{2147}$ x 100 = 3.16%

Lime dosage

Lime slurry is 10%
236 gal x 8.34 $\frac{\text{lbs}}{\text{gal}}$ x .10 = 197 lbs lime

Lime dosage = $\frac{\text{pounds lime}}{\text{Pounds dry solids}}$ x 100 =

= $\frac{197}{2147}$ x 100 = 9.17%

Filter Yield

2147 lbs/2 hrs ÷ 2 hrs = 1073 lbs/hour

1073 lbs/hour ÷ 275 square feet filter area = 3.9 lbs/sq.ft./hr.

EDUCATIONAL CONCEPTS - SCIENCE

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
III-1 (B.1.1.1) (B.1.3.1) (C.2.3)	1. Determination of pH	New York Manual pg, 132, Ref. 1, Chap. 15
	2. Sludge Solids Test	New York Manual pg. 134, Ref. 1, Chap. 22
	3. BOD	New York Manual pg. 134, Ref. 1, Chap. 24
	4. Suspended Solids Test	New York Manual pg. 135
	5. Total Solids Test	New York Manual pg. 136
	6. Alkalinity Test	New York Manual Ref. 1, Chap. 17, Ref. 2, part 201
	7. Sludge Filterability (Buchner Funnel)	New York Manual pg. 142
	8. Specific gravity	
	9. Sludge cake moisture determination apparatus	See Manufacturers Operating Instructions.
Ref. 1	Chemistry for Sanitary Engineers, Sawyer, E.N. & McCarty, P.L., McGraw-Hill Book Co.	
Ref. 2	Standard Methods for the Examination of Water & Wastewater, 13th Edition, APHA.	

EDUCATIONAL CONCEPTS - COMMUNICATIONS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
IV-1 (C.2.2) (C.3.4) (E.1.1-8)	1. Plant Daily Operating Sheet-Section 11 2. Maintenance Report (trouble) 3. Preventive Maintenance File Cards 4. Equipment Inventory Cards 5. Foremans' Daily Report 6. Plant Operating Log	

PROCESS EQUIPMENT

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-1 (A.1.1.1) (E.1.1.1)	Valves	Manufacturers O & M Manual
V-2 (A.2.1) (A.2.2) (A.2.3) (A.2.4) (A.2.5)	Structure & Equipment	Blueprints, Shop Drawings
V-3 (A.1.2) (A.3.1.1) (A.3.2.1) (A.3.3.1) (A.3.4) (E.1.2.1)	Switchgear	Manufacturers O & M Manual, Blueprints
V-4 (A.4.1) (A.4.7.1)	Pumps	Manufacturers O & M Manual
V-5 (A.4.2)	Chemical Conditioning Tank	Manufacturers O & M Manual
V-6 (A.4.3) (E.1.3)	Vacuum Filters	Manufacturers O & M Manual, Shop Drawings
V-7 (A.4.4.1) (E.1.8)	Conveyors	Manufacturers O & M Manual, Shop Drawings
V-8 (A.4.5)	Sludge Cake Scale	Manufacturers O & M Manual, Shop Drawings
V-9 (A.4.6) (E.1.5)	Vacuum Pumps	Manufacturers O & M Manual
V-10 (E.1.4)	Motors	Manufacturers O & M Manual

PROCESS FLOW - CHARACTERIZATION

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VI-1 (B.1.4)	A ferric chloride concentration of 11% will contain one pound of ferric chloride for every gallon pumped. An 11% solution will have a specific gravity of 1.093 which may easily be determined by use of a hydrometer and hydrometer cylinder.	
VI-2 (B.1.5)	A lime slurry in excess of 10% will be too difficult to maintain without excessive sedimentation in the limes and slurry tank.	
VI-3 (C.2.6.1) (C.2.3)	A thin sludge will require more chemicals than a thick sludge; it is best to maintain sludge solids above 7%.	
VI-4 (C.2.2) (C.2.3)	It is best to have the sludge cake as dry as possible. If the sludge is to be incinerated it will generally require little or no fuel if the moisture content is less than 78%.	
VI-5 (C.2.3)	If the filtrate exceeds 500 ppm suspended solids, an undue load may be placed on the other plant process units.	

PROCESS CONTROL

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VII-1 (B1.1.1)	Perform filterability tests to control optimum dosage rate.	
VII-2 (B.1.3.1)	Maintain ferric chloride concentration at one pound per gallon by use of a hydrometer for a specific gravity of 1.093.	
VII-3 (C.2.1.1)	Determine solids concentration by use of 15 minute centrifuge test so that chemical dosages can be calculated and check against automatic proportioner. If calculations do not match proportions, over-ride proportions as necessary.	
VII-4 (C.1.2)	Sludge cake moisture content should be in desired range, as well as approximate to that obtained in the filterability test. If not, adjust variables of operation as necessary.	

ABNORMAL OPERATIONS - TROUBLE SHOOTING

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VIII-1 (C.2.1.1)	If sludge is too thin (3%), attempt to withdraw better sludge in preceding treatment units.	
VIII-2 (C.2.3)	If sludge is too thick (12%+), add water just prior to the chemical conditioning tank. If cake is too wet, decrease filter speed drum or adjust chemical dosage. WARNING!! Too great a chemical dosage can give just as poor results as too little dosage.	
VIII-3 (C.2.2.1)	If filter vacuum is too low check for: 1. premature cracking of cake 2. insufficient lubrication of filter drum head 3. deteriorated flexible connection 4. excessive wear on vacuum pump 5. eroded vacuum lines, especially inside of filter drum	
VIII-4 (C.2.3)	If filtrate solids exceed 500 ppm check condition of media and chemical dosage.	
VIII-5 (C.1.1.2)	If filter is blinding check following: 1. grease 2. improper chemical dosage 3. improper washing of media	

MAINTENANCE PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
IX-1 (E.1.1.1)	Valves	Morrow 9-181, 9-270, 12-3
IX-2 (E.1.2.1)	Pumps	Morrow 9-141, 12-3
IX-3 (E.1.3)	Vacuum Filters	Manufacturers O & M Manual
IX-4 (E.1.4)	Motors	Morrow Sections 7-43, 12-3
IX-5 (E.1.5)	Vacuum Pumps	Manufacturers O & M Manual
IX-6 (E.1.6)	Protective Coating	Morrow 6-33
IX-7 (E.1.8)	Conveyor	Morrow Sections 8 12-3
	1. Organization and Administration of Maintenance Forces	Morrow Section 1
	2. Planning and Scheduling Maintenance Works	Morrow Section 3
	3. Costs and Budgets for Maintenance Operation	Morrow Section 5
	Morrow, L.C., Maintenance Engineering Handbook, McGraw-Hill, New York, 1966, 2nd Edition.	

LABORATORY PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
X-1 (B.1.1.1)	Coagulan selection studies should be carried out on the actual sludge to be treated. Polymer, as well as ferric chloride and lime should be studied. Give consideration to the following: 1. Sequence of addition 2. Time of mixing 3. Speed of mixing	
X-2 (A.4.7.1) (B.1.3)	Use hydrometer to determine specific gravity of ferric chloride from chemical treatment building and then again after dilution. Prepare a nomograph with volume of concentrate needed versus inches down in ferric day tank at the range of concentration expected in concentrated ferric chloride.	
X-3 (C.2.3)	Sample 100 ml at each sampling time for sludge pump discharge. Be certain to label jar properly and refrigerate.	
X-4 (C.2.3)	Lift a piece of sludge about 3" x 3" off of belt at discharge point using a nylon spatula. Place sample in large pickle jar. Keep lid on tight to prevent escape of moisture. In lab the composite cake sample should be shaken out onto a cookie sheet and spread out using a piece of 1/2" copper tubing about 5" in length, jab tubing into sludge at random locations until tube is filled. Extrude this core into prepared sample evaporating dish for analyses.	

INSTRUMENTATION - AUTOMATION

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XI-1 (A.3.4) (A.4.1.1) (A.4.2) (A.4.3.3) (A.4.5) (A.4.7)	Instruments and Instrumentation Instrumentation and Control in Water Supply and Wastewater Proposal by Russell H. Babcock, P.E., Rueben H. Donnelly Corporation.	Morrow Section 13

SAFETY PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XII-1 (A.1.2) (E.1.4)	Make certain circuits are "Dead" and locked and tagged out to prevent electrical shock.	
XII-2 (A.4.1.2) (A.4.2) (A.4.3) (A.4.3.1)	Do not add oil to pump oilers while pump is in operation.	
XII-3 (A.4.3.1) (A.4.3.3)	Use care when operating around oscillating equipment.	
XII-4 (A.4.4.1) (A.4.5)	Use care when working on system under tension.	
XII-5 (B.1.3.1) (B.1.4) (E.1.3)	Chemical handling: 1. Use care in handling all chemicals 2. Body a. Lime-an alkali, flush with water and neutralize with vinegar-water solution b. Ferric chloride-an acid, flush with sodium bicarbonate solution 3. Equipment a. Lime-sweep up dry, hose down liquid to drain b. Ferric chloride-keep away from electrical equipment. Large amounts must be equalized with lime before washing to sump; if not, it will dissolve lead in drain pipes and impellers of pumps. Use extreme caution when working with wetted polymers. These are very slippery under foot and may cause skin irritations.	

RECORDS & REPORTS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES		REFERENCES/INSTRUCTIONAL RESOURCES
XIII-1 (C2.2)	Plant Daily Operating Sheet		
	1. Sludge Fed		
	a. Meter reading		
	b. Gallons/2 hours		
	c. % Solids		
	d. Pounds solids/2 hours		
	2. Ferric Chlorides		
	a. Meter reading		
	b. Gallons/2 hours		
	c. % Dosage		
	d. Rate GPM		
	3. Lime		
	a. Meter reading		
	b. Gallons of slurry/2 hours		
	c. % Dosage		
	d. Rate GPM		
	4. Filter		
	a. Vacuum	Inches High	
	b. Drum speed setting		
	c. Yield lbs/sf/hr		
	5. Filter operation	Hours	
	6. Vat Agitator Speed Setting		
	Monthly Operations Report		
	1. Sludge filtered	Gallons	
	2. Sludge solids filtered	%	
	3. Sludge solids filtered	Pounds	
	4. Chemicals Used		
	a. Ferric chloride	Pounds	
	b. Ferric chloride dosage	%	
	c. Lime	Pounds	
	d. Lime	Dosage %	
	5. Filter yield lb/sf/hr		